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ANALYSING THE PAYLOAD ENVELOPE RATE FOR SONET (STS) & SDH (STM) BASED DIGITAL NETWORK

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ABSTRACT: Synchronous Optical Networking & Synchronous Digital Hierarchy are standardized protocols it transfer multiple digital bit streams with same period & phase over optical fiber using lasers or highly coherent light from light-emitting diodes. At low transmission rates data could also be transferred via an electrical interface. method was developed to replace PDH system for carrying big amounts of telephone calls & data traffic over same fiber without same period problems. SONET generic criteria are detailed in Telcordia Methods Generic Requirements document GR-253-CORE. Generic criterion same to SONET & different communication system (e.g., asynchronous fiber optic management or digital radio systems) are found in Telcordia GR-499-CORE.

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[1] INTRODUCTION

To satisfy requirements of increasing data rate for differing from each other applications; ANSI developed standard known as Synchronous Optical Network (SO-NET) by utilizing enormous bandwidth of optical fiber. Another similar standard developed by ITU-T would be known as SDH. SO-NET would be American National Standards Institute standard with same period data transmission on optical media. international equivalent of SO-NET would be synchronous digital hierarchy. Same here; they ensure standards so it digital networks could interconnect internationally & it existing conventional transmission systems could take advantage of optical media through tributary attachments. SO-NET had been proposed by Bell core in middle 1980s & would be now ANSI standard. SO-NET defines interface standards at physical layer of OSI seven-layer model. standard defines hierarchy of interface rates it allow data streams at different rates to be multiplexed. SO-NET establishes Optical Carrier (OC) levels from 51.8 Mb ps(OC-1) to 9.95 Gbps. Prior rate standards are used by different countries specified rates it had been not compatible for multiplexing. With implementation of SO-NET; communication carriers throughout world could interconnect their existing digital carrier & fiber optic systems. Short for **S**ynchronous **O**ptical **Net**work; standard for connecting fiber-optic transmission systems.

STS	OC	Raw (Mbps)	SPE (Mbps)	User (Mbps)
STS-1	OC-1	51.84	50.12	49.536
STS-3	OC-3	155.52	150.336	148.608
STS-9	OC-9	466.56	451.008	445.824
STS-12	OC-12	622.08	601.344	594.432
STS-18	OC-18	933.12	902.016	891.648
STS-24	OC-24	1244.16	1202..688	1188.864
STS-36	OC-36	1866.23	1804.032	1783.296
STS-48	OC-48	2488.32	2405.376	2377.728
STS-192	OC-192	9953.28	9621.604	9510.912

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Table 1 Synchronous transport signals & optical carriers

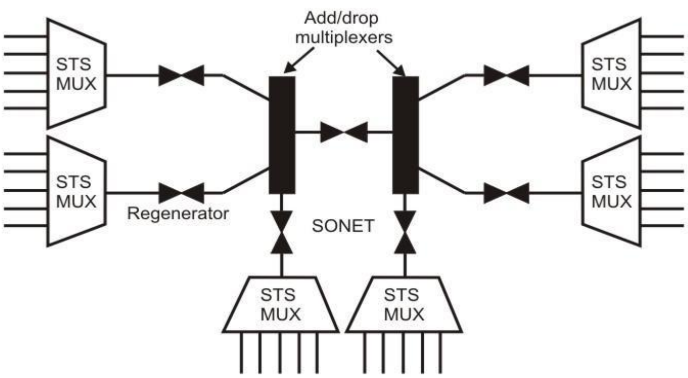

Fig 1 Devices used in SO-NET system

Physical Configuration & Network Elements

Three basic devices used in SO-NET system are shown in Fig. 1. Functions of three devices are mentioned below: Synchronous carry Signal multiplexer/demultip lexer: It either multiplexes signal from multiple sources into STS signal or demul tiplexes STS signal into different destination signals. Regenerator: It would be repeater it takes received optical signal & regenerates it. It functions in data link layer.

[2] LITERATURE REVIEW

1.A research conducted by Mr. Sanjay Kumar in 2010 titled "Simulation of Next Generation SONET/SDH states it according to them Internet had been growing from a small research network to a global network it we use in each day. Network traffic desires have grown quickly over last few years. Traffic is believed to have grown 100 times between 2000 & 2002 & at 100% each year. limits of our current computer & telecommunication networks are testes by rapid expansion of Internet & ever increasing demand for multimedia information. need for development of new high-capacity networks is required for supporting growing bandwidth requests. Optical networks is a possible answer to put up this rapid growth. In all optical network, data packets were reserved in optical format from door to door. According to optical buffering technology in electronic networks are challenging to apply in all - optical network. Internet Protocol (IP) to place information in packets are used for nearest router is when a host wants to communicate with other hosts.

2 .SONET/SDH Optical Transmission System

This paper describes Fujitsu's SONET/SDH transmission system. Fujitsu produces Fujitsu Lightwave Add/Drop Shuttle (FLASH) series, which conform to SONET/SDH standard. FLASH series was well received in North America market. Also, this paper describes Fujitsu's plans for future equipment & key technologies used in some of Fujitsu's new optical communication systems.

3. In another research by Mr. Bhupesh Bhatia, Mr. Vijay Raj Shokeen & Dr. Narendra Kumar Verma in their research titled "Difference Between Sonet & Obs On Basis Of Block Diagram" Introduced To Sonet & Optical Burst Switching & compare them on basis of various parameters. Firstly, Sufficient amount of information is provided so it beginner could understand underlying technology. After it a light is thrown on early work on burst transmission incorporated by characterize of a new emerging protocol for SONET i.e. (NGSONET) & then OBS networks called Just-Enough-Time (JET) & WB-OBS are considered.

4 Research titled "**Analysis, Optimization of SONET/SDH Technology for today & future aspects**" by Gourav Verma & Deepika Ramaiyais dedicated to analysis & review of literature for today's technology & future aspects of optical networks. This in deep analysis of today's SONET/SDH Architecture & Reconfigurable structures for SONET rings had been discussed so it one could formulate next generation SONET/SDH networks. Network layers are analyzed for their design & issues of

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researches, while dense wavelength division multiplexing equipment had been deployed in networks of major telecommunications carriers for a long time, efficiency of networking & relation with network control & management have not been caught up to those of digital cross-connect systems & packet-switched counterparts in higher layer networks. In this paper, focus on issues by understanding current structure of SONET/SDH Layers, its connection to other network technology layers. It would be useful for current OPMA

.

[3] Fundamentals of SONET/SDH

When data is transmitted over a communications medium, including framing of data, error checking, & ability to manage link . For optical communications these functions have been standardized by ANSI T1X1.5 committee as Synchronous Optical Networking (SONET) & by ITU as Synchronous Digital Hierarchy (SDH). Although there are a lot of similarities between SONET & SDH, there are some significant differences, especially in terminology. In an attempt to avoid confusion, we have focused primarily on SONET & SONET terminology because **SONET is a subset of SDH**. Once we understand SONET, it's easier to understand SDH. There are a number of things in SDH which don't make sense until you realize it SDH had to do it it way to maintain compatibility with SONET. Currently, SONET is more widely used in North America, while SDH is more large range deployed in Europe. So lets first understand difference between SONET & SDH.

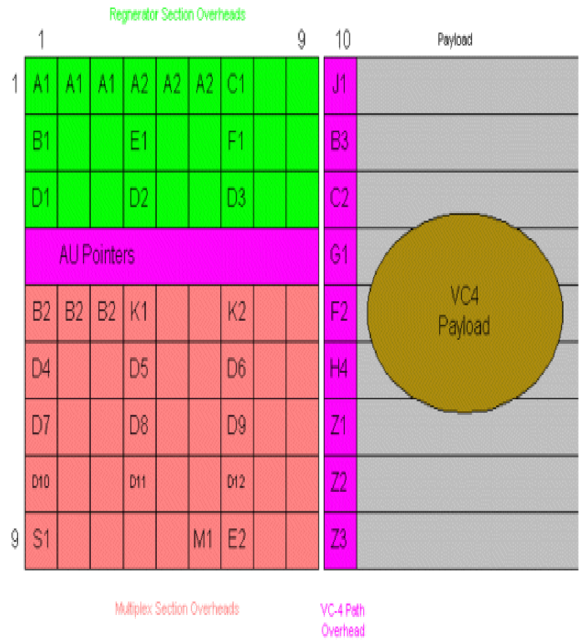

Figure 2 Section & VC-4 Path Overheads

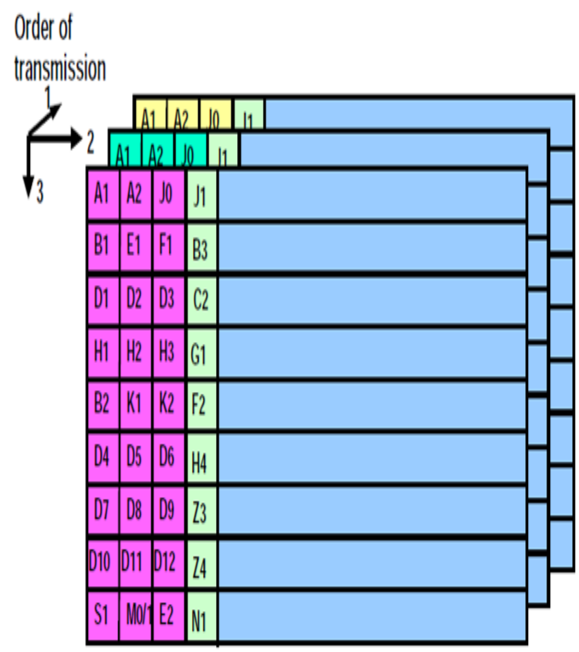

Figure 3. Interleaving of three SONET STS-frames into an STS-3 frame

SONET/SDH Interleaving

An STS- 3 could be thought of as three STS-1 bit streams transmitted in same channel so it resulting channel rate is

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three times rate of an STS-1. & when multiple streams of STS-1 are transmitted in same channel, data is octet multiplexed. For example, an STS-3 signal would transmit octet A1 of stream 1, then octet A1 of stream 2, & then octet A1 of stream 3, then octet A2 of stream 1, octet A2 of stream 2, etc. This multiplexing is carried out for all levels of SONET & SDH, including STS-192 & STS-768. Because of this, SONET/SDH maintains a frame time of 125s.

[4] Proposed Work

Algorithm

1. read line rate lr for sonet(STS) & sdh(STM)
2. here initial line rate in case of STS-1=51.84
3. SET N=3
4. SET STS-N=STM-(N/3)=N*51.84
5. N=N*4
6. Repeat step 3 & step 4,STEP 5 until N<=768

Here we have wrote matlab code corresponding to above algorithm. We would create a matlab file by .m extension

Matlab based Implementation

```
a111=[]
b11=[]
a1x=[]
c11=[]

counter=1;
value=51.84;
a111(counter)=1;
b11(counter)=51.84;
c11(counter)=0;


i=3;

while i<=768
   counter=counter+1;
   a111(counter)=i;
   a1x(counter)=i/3;
   t=i*51.84;
   b11(counter)=t;
   c11(counter)=t;


   i=i*4;

end
a111
b11
a1x
c11
plot(a111,b11,'r+-');
hold on;
plot(a1x,c11,'g*-');
legend('SONET','SDH');
```

Algorithm

1. read synchronous payload envelope rate for sonet(STS) & sdh(STM)
2. here initial line rate in case of STS-1=50.112
3. SET N=3
4. SET STS-N=STM-(N/3)=N*50.112
5. N=N*4
6. Repeat step 3 & step 4,STEP 5 until N<=768

Here we have wrote matlab code corresponding to above algorithm. We would create a matlab file by .m extension.

```
a111=[]
b11=[]
a1x=[]
c11=[]

counter=1;
value=50.112;
a111(counter)=1;
b11(counter)=50.112;
c11(counter)=0;


i=3;

while i<=768
   counter=counter+1;
```

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```
    a111(counter)=i;
    a1x(counter)=i/3;
    t=i*50.112;
    b11(counter)=t;
    c11(counter)=t;


    i=i*4;

end
a111
b11
a1x
c11
plot(a111,b11,'r+-');
hold on;
plot(a1x,c11,'g*-');
legend('SONET','SDH');
```

[5] Result & Discussion

Information is sent over an optical fiber by turning light off & on in fiber. For example, suppose it presence of light indicates a "1" while absence of light indicates a "0". Just knowing this much we could send & receive bits across an optical link.

But how do we extract information from those bits? This is where SONET/SDH comes in. SONET/SDH defines low level framing protocol used on these optical links. By "framing", we mean a block of bits (or octets) which have a structure, & which utilize some technique which allows us to find boundaries of it frame structure.

SONET name	**SDH name**	**Line rate (Mbps)**	**Synchronous Payload Envelope rate (Mbps)**	**Transport Overhead rate[7] (Mbps)**
STS-1	None	51.84	50.112	1.728
STS-3	STM-1	155.52	150.336	5.184
STS-12	STM-4	622.08	601.344	20.736
STS-48	STM-16	2,488.32	2,405.376	84.672
STS-192	STM-64	9,953.28	9,621.504	331.776
STS-768	STM-256	39,813.12	38,486.016	1,327.104

Table 2: SONET/SDH digital hierarchy.

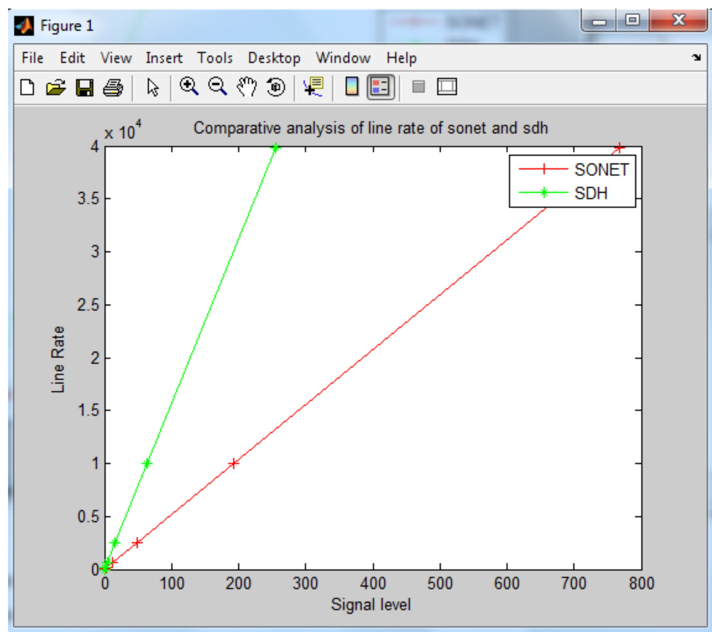

Fig 4 comparative analysis of line rate in case of SONET & SDH

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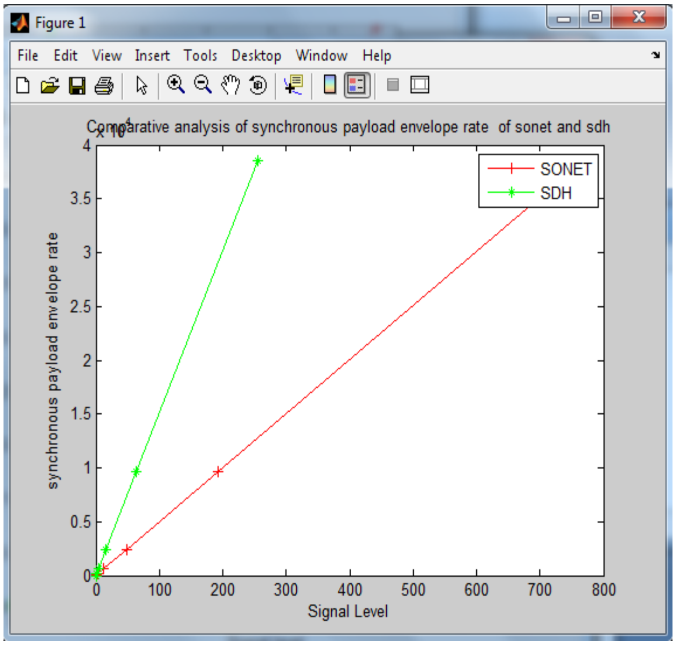

Fig 5 comparative analysis of synchronous payload envelope rate of sonet & sdh

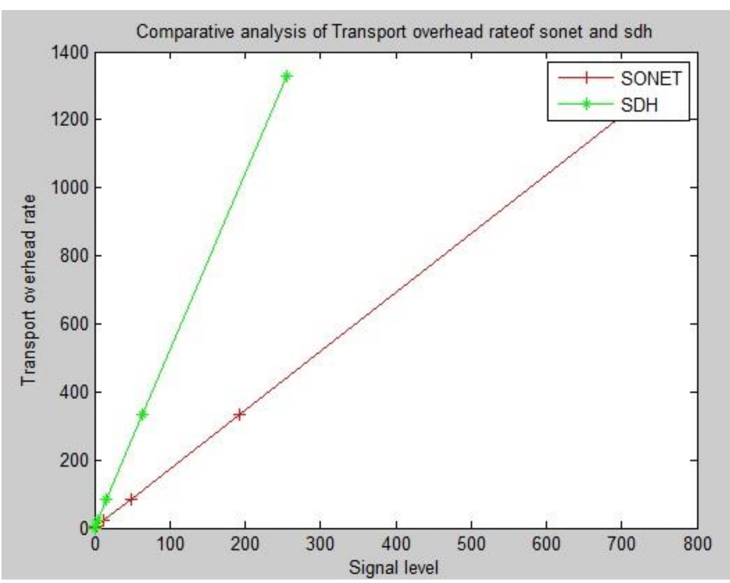

Fig 6 comparative analysis of transport overhead rate of sonet & sdh

[6] CONCLUSION

The **line rate** is a physical layer term that has nothing to do with the **line** cards or switching fabrics. It indicates the actual speed with which the bits are sent onto the wire (and is thus also known as physical layer gross bit **rate**). SONET is consider better as there is no standard for SDH in case of 51.84 Mbps. Sonet is working at all rates. Here payload is User data (774 bytes for STM-0/STS-1, or 2,340 octets for STM-1/STS-3c) In case of STS-1, the payload is referred to as the synchronous payload envelope (SPE), which in turn has 18 stuffing bytes, leading to the STS-1 payload capacity of 756 bytes.The STS-1 payload is designed to carry a full PDH DS3 frame. When the DS3 enters a SONET network, path overhead is added, and that SONET network element (NE) is said to be a path generator and terminator.

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